TRANSMISSION ADEQUACY

Adding large amounts of wind power will usually require investment in the transmission grid. The need for new grid investments to accommodate wind power depends on the location of the wind plants, and the strength and characteristics of the existing grid. The resulting improvements to the transmission grid benefit the whole power system, and thus the cost is normally not allocated to a single power plant or technology.

How much new transmission investment is needed for wind power?

Any new power plant usually requires a new line to connect it to the existing power grid. Smaller wind power plants will be connected to a lower voltage distribution grid and larger wind power plants to a higher voltage transmission grid.

The need for new grid investment for wind power depends on the location of the wind plants and the strength and characteristics of the existing grid. While upgrades to existing transmission lines may be needed to accommodate the added power from the new plant, there are also other needs to reinforce the existing grid, like increases in electricity consumption (demand).

The distance between location and utilization usually means that wind power requires, on average, more transmission than conventional generation, as shown for China and Germany in Figures 1 and 2.

Does wind power require other changes in the transmission network?

New wind power plants will alter how the power flows through the existing transmission (or distribution) grid.

The power flow direction may change, resulting in increased or decreased losses in transmission and distribution. Wind power may also increase or decrease bottleneck situations or congestion.

Figure 1. *Example of wind power buildout from China that requires new transmission links. Large wind power plants are planned in the Northern part of China where there is not much consumption. Extra high voltage transmission lines are planned to transfer the power to load centres. (Source: SGERI).*

These will have to be taken into account in the operation of the network. Sometimes an increase in bottleneck situations will require upgrades to the transmission lines. Other times, alternative and more cost effective means to help operation will suffice, like using more of the existing line capacity (dynamic line rating) or investing in auxiliary devices like Flexible Alternating Current Transmission systems (FACTs).

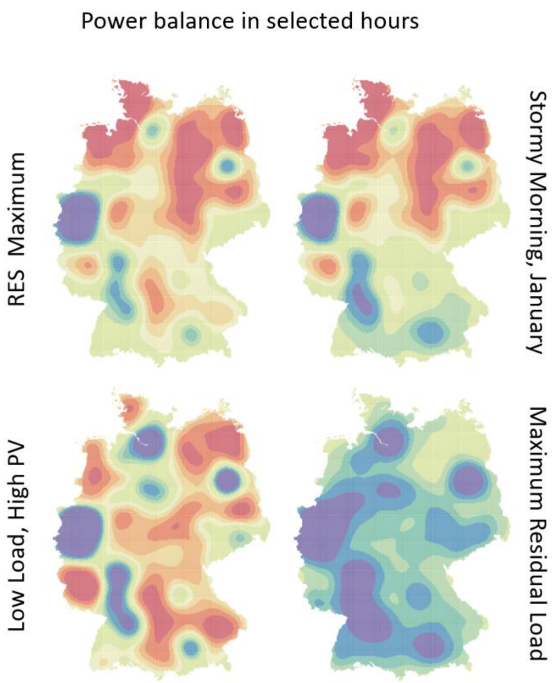

Figure 2. *In Germany, wind power is increasing more rapidly in the north, where it is creating power surplus situations (power balance in red). The consumption is mostly in the south, where some conventional power plants are planned to be retired. This situation will increase the power deficit (power balance in green) and will require upgrading the north-south transmission. (Source: German TSOs).*

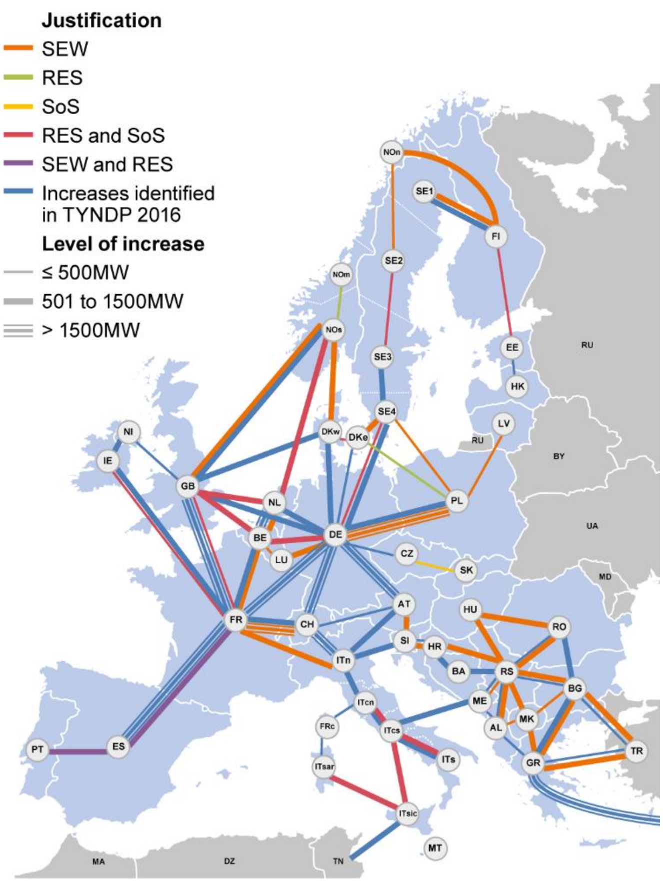

Figure 3. *European-wide analyses on grid reinforcement needs. The green lines show the lines where the justification for building is mainly due renewables. (Source: ENTSO-E TYNDP, 2018, scenario for year 2040 called Global Climate Action).*

How much does the transmission network increase the cost of wind power?

When a transmission line is built, it benefits the whole system because the lines are integrated and power flows through all existing lines as needed. For this reason, transmission cost is normally not allocated to a single power plant or technology. The transmission reinforcement projects serve several purposes at the same time. These are usually the integration of the energy market (IEM), ensuring security of supply (SoS) and integration of new (renewable) production (RES) and consumption (Figure 3). Each transmission project changes its economical value depending on the expected future scenario.

Numerous studies trying to allocate the transmission system costs of wind energy show that the investments are reasonable. Overall, transmission is only a small fraction of the total energy price for consumers.

Solar power is in many cases different from wind energy in that it is built more distributed. However, in cases where large solar power plants are connecting to the grid, much of the same applies as for wind energy. It is good to note that here can be a synergy in planning transmission with wind and solar given they have different diurnal and seasonal patterns.

Associated publications

- Holttinen, H. et al. (2019). **Design and operation of power systems with large amounts of wind power**. Final summary report, IEA WIND Task 25, Phase four 2015–2017. https://community.ieawind.org/task25/ourlibrary
- Smith, J.C. et al. (2013). **Transmission planning for wind energy in the United States and Europe: status and prospects.** WIREs Energy and Environment, 2, 1–13. https://doi.org/10.1002/wene.8
- ENTSO-E (2018). **Ten Year Network Development Plan** (TYNDP). https://tyndp.entsoe.eu/tyndp2018/

More information

This Fact Sheet draws from the work of IEA Wind Task 25, a research collaboration among 18 countries. The vision is to provide information to facilitate the highest economically feasible wind energy share within electricity power systems worldwide. IEA Wind Task 25 works on analysing and further developing the methodology to assess the impact of wind power on power systems.

See our website at
https://community.ieawind.org/task25

See also other fact sheets

Impacts of Wind Power on Power System Stability Fact Sheet
Balancing Power Systems with Wind Power Fact Sheet
Wind Integration Issues Fact Sheet